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ABSTRACT

Broad areas of communications media used in technical training in specific occupational skills within the armed forces are examined in the first part of this report. These areas include: traditional audiovisual media, television, the techniques of programed instruction and instructional systems development, and the use of computers. In the second part, the instructional technology used in officer training of all kinds within the armed services is described, and in the final section, implications and trends for the future are presented. (SP)

INSTRUCTIONAL TECHNOLOGY IN THE ARMED FORCES

by Lt Colonel Howard B. Hitchens, Jr.*

I. Technical Training

The vast amount of technical training in specific occupational skills within the armed forces is conducted to insure that adequate numbers of well-trained personnel are available to accomplish the tremendously complex job of defending the nation. Any view of armed forces training programs must be taken with that in mind---the armed forces conduct training as a means to assure the accomplishment of a specific mission.

The use of communications media in military technical training ranges from such rudimentary tools as the chalkboard to the very sophisticated computer. This report discusses the following broad areas:

a. traditional audiovisual media
b. television
c. the techniques of programmed learning and instructional systems development
d. the use of computers

The scope of the use of traditional audiovisual media (films, audio tapes, slides, transparencies, etc.) is difficult to depict. Since World War II the military services have depended greatly on such tools of communications for their training programs. As an example of the amount of effort and material that goes into training, Ft. Monmouth, New Jersey, produced more than 13,000 transparencies for the overhead projector for use in its training

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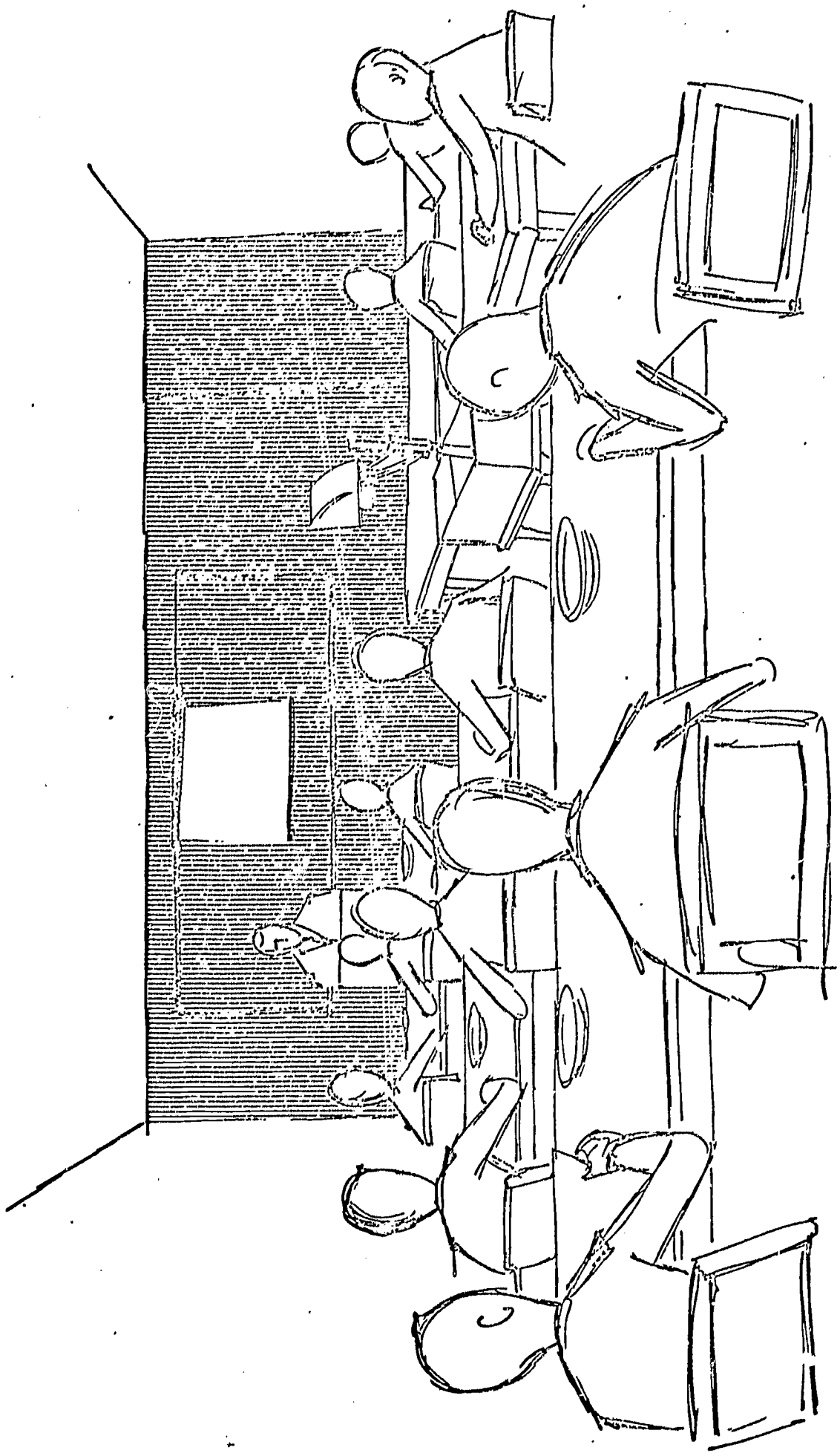
program in a recent academic year. In a recent year, Lackland Air Force Base produced more than 1,500 training devices of all kinds, and Keesler Air Force Base produced 4,000 graphics (flip-charts, posters, etc.) The inventory in each of the armed forces of such communication devices as overhead projectors, 35 mm slide projectors, and the like, runs into the millions of dollars. These devices are used not only in the formal training conducted by Continental Army Command, Air Training Command, and the Naval Schools Command, but also in on-the-job and follow-up training on shipboard in the Navy and the various operational sites in the Army and Air Force.

A typical military classroom is equipped with at least one wall of chalkboard, a projector screen, and an overhead projector (see illustration, page three). Generally, equipment for the projection of 2 by 2 slides and 16 mm motion pictures and a complete array of visual materials are available on request.

Each of the services has an instructor-development program, which includes formal pre-service training for the military instructor. This training may be conducted at one central school facility (for example, the Academic Instructors' Course is required of each Air Force ROTC instructor) or an individual



base-or-unit-level course. Without exception, training in the use of these conventional AV tools and materials is a required part of the course. Each of the services has a system of certifying the competence of the graduating instructor, usually by issuing him an AV equipment operator's license.

Television

Television is no longer a new medium of instruction within the military services. The Navy and the Army experimented with the use of television for various training purposes as early as 1949. The Army and Navy training establishment, or civilian institutions under contract with Department of Defense, pioneered research in the instructional uses of television. It would be nice to report that the television applications to training in the armed forces have been very carefully selected. Such is not the case.

The development of television has evolved in the same manner within the military services as it has within the civilian sector. Its introduction into training has occurred for reasons that range from seeking solutions to various training needs, to satisfying the felt needs of responsible individuals in the training process. For instance, the very large television distribution system which serves US Army's Continental Army Command (CONARC) was introduced to achieve standardization and more effective training methods in the technical training of Army enlisted men. There are presently 12 regional television production centers within CONARC which annually produce 1500 selected segments of courses on video tape for distribution to training programs at 26 CONARC posts. The

largest distribution system consists of 30 channels used in training at Fort Gordon, Georgia. Over 200,000 programs are transmitted annually on this closed circuit educational television system in direct support of USCONARC training. An added benefit to Army training is derived from the CONARC TV System in the increased production of low-cost Army-wide training films (FY69---150 reels) using television techniques and transferred to 16mm kinescope film.

Currer :ly the most exploited television capability is the providing of self-confrontation for students in instructor training. The small portable television record-and-playback units provide a very powerful means of allowing a person "to see himself as others see him."

The large television production systems have usually been established to provide experiences for the military classroom which could not be provided in any other way. For example, the bringing of a "real time" missile firing from Cape Kennedy into the classrooms at Redstone Arsenal, Alabama, was not possible before television. Since 1959 the television production facility at Redstone Arsenal has grown into one of the larger production centers in the Army. Similarly, the Air Force's Lowry Air Force Base introduced television into its technical training program in 1958, and it has since evolved into a large multi-faceted television production facility.

Part of the early evolution of television was to exploit its rapid recording capabilities---even before the advent of videotape. In the late 1950's the Army Pictorial Center developed a technique of making quick release films using kinescope facilities. This use of television capabilities continues to the present day, allowing rapid production of audio-visual programming through the television medium. In 1959, an entire course in Basic Electronics was produced on an experimental basis at Lowry Air Force Base. After demonstrating its effectiveness for technical training, the recorded materials were transferred from videotape to film and distributed to other Air Force technical training centers as films.

At present, the Army, Navy, and Air Force employ television extensively for training. Typical uses of television include:

1. Recording of dangerous or otherwise inaccessible phenomena for playback in the classroom.

2. The demonstration of manipulative tasks.

3. Introductory lectures on subjects ranging from technical to non-technical.

4. Enlargement or image magnification for demonstration purposes.

5. The aforementioned instructor training.

The administering of tests live through the television medium has been accomplished in several instances. Also, some use of the television medium has been made to lead students lock-step through programmed sequences.

One of the most unusual and innovative uses of television is the Navy's PLAT System (Pilot Landing Aid-Television). Television cameras and recorders on aircraft carriers monitor and record every aircraft landing. This enables the pilot and his supervisor to replay every detail of the landing---a superb tool for performance improvement.

In assessing each of the separate services' role in the use of this medium, it seems that the Army has consistently played a highly dominant role in the development of television for instruction. Most of the early research and experimentation that was accomplished was done either within the Army or under its auspices.

Programmed Learning

The programmed learning movement within the Armed Forces got its biggest boost within the Air Force, and not quite by accident. Soon after its inception in 1947, the Air Force exerted a significant effort in human factors research; it assembled a large number of highly skilled educational psychologists in dispersed research laboratories located at each of its training centers. Such people as Gagne, Lumsdaine, Crowder, Evans, Homme, and Glaser (all prominent behavioral psychologists today) worked in these laboratories. Much of their best thinking and many of their greatest contributions to the programmed learning movement came during their tenure in the Air Force. Unfortunately, these research and development laboratories were eliminated and the training research reduced in 1958.

In 1961 the Air Force's Air Training Command (ATC) introduced the concepts of programmed learning into its technical training programs. The use of these techniques involved systematic evaluation of the entire training process. As a part of this effort, ATC established Instructional System Development Teams at each of its technical training centers. These teams analyzed entire training segments and restructured courses in programmed

form. This effort evolved into the Instructional Systems concept which all three armed services presently employ. Table IV depicts the commonly agreed upon steps in systems analysis which the Army, Navy and Air Force use at this time.

Table IV

INSTRUCTIONAL SYSTEM DEVELOPMENT STEPS

1. Collect job data and analyze.
2. State training objectives.
3. Design: Content, Method, Media.
4. Construct course.
5. Field Test (Includes evaluation).
6. Implement.

Although the first course used for experimentation in each service's innovative surge was Basic Electronics, the courses in technical training which now employ programed instruction run the gamut from Electrical Theory, Applied Aerodynamics, Mathematics, Physiology, Mechanical Principles through various specific procedural tasks and such mundane subjects as first-aid. In a few instances the programed materials are used as the sole vehicle to accomplish the training. Virtually all of the programed

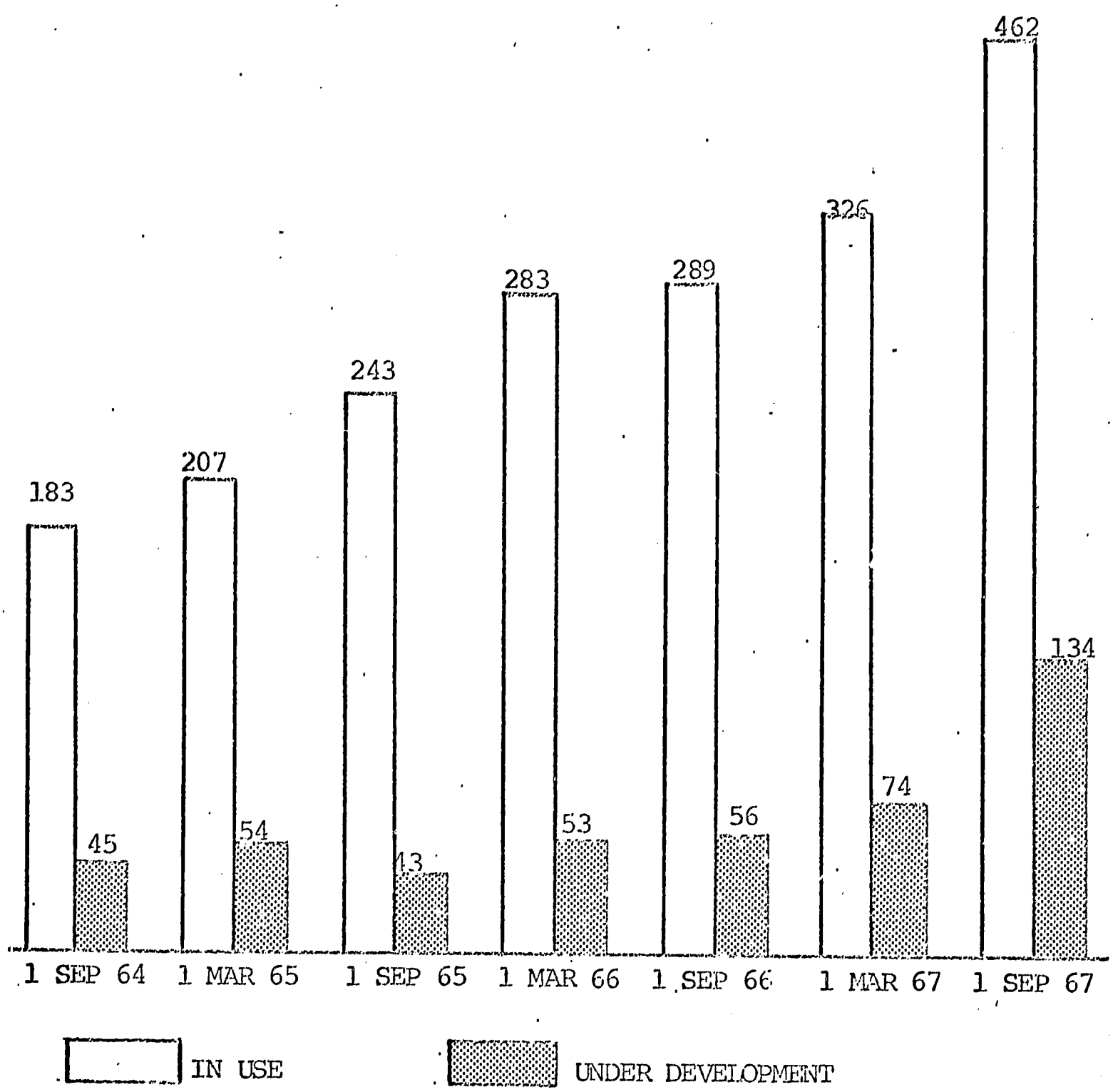
materials at this time are in textual form.

The growth in the use of programed instruction (PI) in the Air Force is depicted in Figure 1. Although a steady growth in its use is shown, PI has not been the panacea for training that the early enthusiasts predicted.

One of the most effective applications of programed learning has been in the school program of the Army Security Agency at Ft Devens, Massachusetts. The systematic analysis that was made of jobs and tasks in the field resulted in significant changes in training and in the Military Occupational Specialties (MOS) descriptions. The training managers at Ft Devens succeeded in changing the MOS descriptions based on their findings during the task analysis.

Currently the Department of the Army has initiated a five year program in all USCONARC schools and army training centers to redesign existing MOS producing courses, functional courses, career courses and Army Subject Schedules, based on techniques of systematic analysis.

The Memphis Navy Air Training Center has introduced programed instruction rather extensively. Twenty-five courses use some programed instruction materials. As of Fall, 1968, 411 PI booklets were in use; an additional 33 were completed and ready



U. S. AIR FORCE PROGRAMED INSTRUCTION SUMMARY

FIGURE I

for use. Training managers at the Memphis Training Center have reduced training time by twenty-eight percent after introducing PI and have saved 235 man years in 1968 alone. Table V depicts some statistical data which was accumulated at Memphis. The costs shown seem to agree with those costs and savings which have been publicized by experimenters in civilian institutions and industrial training. In the Naval Schools Command, symbol learning has been programed for electronic maintenance training, and, as a result, has moved out of the classroom to "homework".

Table V

PROGRAMED INSTRUCTION DATA

Naval Air Technical Training Command

Amount of programed instruction time savings - 43%

Amount of programed instruction required to save one contact hour - 2 1/2 hours

Cost of producing one hour of P. I. - $278 (direct labor)

Cost of producing 2 1/2 hours - 2 1/2 x $278 = $695

Airman 3rd class hourly pay rate = $1.36

Number of student outputs required to amortize 2 1/2 hours P. I. in one year = $695 - $1.36 = 511

Quarterly rate of production, 60 programmers = 78 conventional hours

Programer manhours per instructional hour - 78

Similar developments in the use of programed instruction have occurred within the Army. At Fort Rucker, Alabama, the United States Army Aviation School redesigned the entire Helicopter Instrument Flight Course by converting academic instruction to programed format and adapting the technique of programed, self-paced instruction to the flight and synthetic flight training. This redesign resulted in a significant reduction in course length. The Primary Helicopter School, Fort Wolters, Texas programed the entire portion of the primary helicopter course. In both instances, programed materials carry the entire instructional load. At Ft Sam Houston's Medical Field Service School, approximately 300 contact hours contain some use of programed instruction materials. In the Army's Signal School at Ft Monmouth, New Jersey, 44 courses out of a total of 158 courses are using programed instruction.

The San Diego Naval Training Center initiated a three week programers course in order to develop programing talent within the Navy. By Fall 1968 ten programmers had been produced---and efforts in one school had resulted in twenty-four completed programs; eight more were in production; and seventy-five course hours had been replaced by the completed programed instruction packages. The school in which this effort was couched was also re-writing all of its course objectives.

The best characterization of the effects of programed instruction throughout the Armed Forces was stated by the educational advisor to the San Diego Service School Commandant, "PI has caused a 'cleansing' of the curriculum." He meant that the systematic analysis of training needs and procedures induced by programed learning methods was very healthful. All of those personnel in Armed Forces Training contacted by the investigator were generally enthusiastic about the potential, if not demonstrated, effects of programed instruction in making military training more productive. The general time saving of thirty percent is typical of military experience.

The most significant problem with the introduction of programed instruction has been the fact that its use generally means the loss of the "lock-step" scheduling and control of students which is normal in military training. As a result, it is difficult for the personnel system to accommodate itself to irregular production of skilled graduates from training courses. As indicated above, the Ft. Devens experience of re-writing job descriptions (a combined effort by the trainers and personnel managers) demonstrated a beneficial procedure that can be useful throughout the Armed Forces.

Multi-Media Packages

One effect that can be attributed to the introduction of the systems analysis technique to military training programs has been a fresh look at the way in which conventional media are employed. Navy and Air Force headquarters staffs both indicated that the development of slide/tape instructional packages has made a significant contribution to their training programs. The skills involved in Navy pilot proficiency lend themselves to this technique. In fact, these sound slide packages, prepared by civilian contract firms, are extensively used in Naval aviation. Keesler AFB has also introduced a large number of slide tape/ packages.

The EDEX (commercial name, from educational excellence) Multi-Media Controlled System has been employed in driver training in both the Army and Air Force. The heart of the system, the programming console, permits the instructional programmer to carefully control the sequence of visual and auditory stimuli to which the students are exposed. The system is a "closed loop" in that student responder stations are integrated into it and determine the direction that the program moves in each instance. Again, the Armed Forces have used this system to satisfy a specific training need--driver education leading to the safe operation of motor vehicles. The Air

Force plans to introduce this system with a packaged driver education course (all the necessary software in addition to the hardware) at most of its bases which have large personnel populations. Two years of feasibility studies have demonstrated that this system will, in fact, significantly reduce motor vehicle accidents.

In December 1968 the United States Army Infantry School, Fort Benning, completed a six months operational report on the effectiveness of the EDEX Instructional Systems. The recommendations contained in this report will be used as a basis for the possible extension of EDEX within the CONARC school system.

A similar evaluation is being conducted by the Air Force under the aegis of the Inspector General's office. Finally, the use of the device for training is being explored by other governmental agencies, such as the Internal Revenue Service, with Air Force assistance.

Uses of the Computer

As in the case of the Air Force's identification with the development of instructional systems and programmed learning, and the Army's identification with the development of television for instruction, the Navy seems to have the primary thrust for the development of computer uses for training in the Armed Forces. Most of the credit for this image goes to the major research and development projects being accomplished at the U. S. Naval Academy, but several other activities within the Navy are using computers within the general training context.

Computer Managed Instruction attempts to exploit the computer's ability to handle large amounts of data. A practical development of this mode is occurring at the Naval Air Technical Training Center, Memphis. Here the computer manages students' programs through carefully structured learning situations. Besides managing, the computer teaches the student in the tutorial mode and exposes him to individual audiovisual devices and programmed instruction booklets. The employment of this training concept has the potential for large, immediate payoff since this Center has a student population of 40,000 per year (14,000 at one time).

Although the Navy seems to have captured the leadership at the moment, all three services have been interested in the development of the computer within the context of the man-machine

interface for years--specifically for training. Some activities within the Army and the Air Force have promise of great effectiveness. The tutorial mode is being used within the Army at Fort Monmouth, New Jersey. Basic Electronics training has been conducted on an experimental basis to determine cost effectiveness of CAI. The initial study resulted in no significant differences in student achievement, but did achieve a time saving of eleven percent. The researchers concluded that if a twenty percent saving of course time could be made, CAI would be cost effective.

The Army's Quartermaster School has under development the simulation of real life logistical situations on the computer. At Fort Benning, Georgia, the Army's Infantry School uses on line terminals with gaming information in order to teach strategy and tactics. A long-range Automatic Data Processing Systems (ADPS) Master Plan for the USCONARC schools system has been developed to satisfy its schools' academic and administrative mission. This plan is open ended to permit revision as necessary to insure that it stays in harmony with computer technology development in the school academic and administrative fields.

The Air Force is conducting a project aimed at exploiting the computer to teach the skills necessary to operate it. This project is associated with the massive buy of so-called Phase II Computers (Burroughs 3500s) for use throughout the Air Force. The development

of software for this project is under contract to Systems Development Corporation.

An earlier project for the Air Defense Command was the development of a computer capability to handle the presentation of training sequences to train operators of the BUIC (Backup Interceptor Control) air defense system. This effort was accomplished by contract with Systems Development Corporation and was eminently successful. The Burroughs 3500 Operator Training Project is a refinement of this earlier effort.

The longest continuous project for the development of computer use in education is Project PLATO at the University of Illinois. This project has been funded repeatedly by all three services, and has provided a great deal of basic information concerning computers.

The most effective use of the computer to control student responses noted by this investigator was at the Army's security school. Here a dedicated CDC Computer is employed to present both Morse code information and typewriter keyboard displays to develop a simultaneous ability to the students to type Morse code responses. The classroom in which this training takes place is equipped to accommodate approximately thirty students at individual carrels. This project is in the advanced development

stage and has processed more than 400 students quite successfully. The project manager cited the following advantages:

a. The computer based code trainer provides for individual differences in terms of quantity, quality, and rate.

b. The teacher can discriminate between typing errors and perceptual errors.

c. The cognitive perception rate of the student is stored and easily handled by the computer.

Simulation

One sphere of training activity in which the military is distinctly different from civilian education is in the use of simulation: providing a student training environment similar to the actual operations the student is learning will occur. An obvious example was the development of the Link Trainer to support pilot training during World War II; the Link Trainer, improved since World War II, is still with us. Many more sophisticated simulators have been developed and used since that time. Most expensive simulators are normally associated with weapon systems (aircraft, missiles, submarines, space vehicles) and are usually provided by the contractor at the time that the system is perfected and delivered. It is difficult to determine the exact number of simulators of all kinds that the Armed Forces presently employs. However, in Navy aviation training support alone there are presently some 215 major simulators in use and approximately 2,000 smaller portable simulators.

In the Navy, simulators are controlled and provided by the Navy Training Device Center. This is a centralized activity which has not only the logistical and distributive job, but also the research and development responsibility in support of Navy training.

Incidentally, the Army Training establishment makes considerable use of the Navy Training Device Center's capabilities to manufacture and distribute various devices for Army training. The Air Force generally manages its major training simulators within the Air Training Command, and does not depend on the Navy Training Device Center.

One interesting attempt to simulate the operational environment is the "captive helicopter" used in Army aviation training at Ft. Rucker, Alabama. In this instance, a light helicopter was linked mechanically to a fixed ground control apparatus and was found to be a very useful way of accomplishing some flight maneuver training for Army aviation student helicopter pilots.

Simulators are used a great deal in the development of crew skills such as pilot and air crew, submarine crew, deck crew, tank crew and other performance skills in all three services. An entire ship has been reconstructed on land at Treasure Island for training in fire control procedures by the Naval Schools Command. Also a completely free floating ship's hull is used to train damage control technicians in emergency shoring of the ship's hull and structure during emergencies. In the latter case, a failure by the trainees results in a soaking as the hull takes on more water--a very practical simulator.

The discussion of simulators would not be complete without some mention of the use of the digital computer for this purpose. Some work is being accomplished in the area of mathematical representation of physical phenomena and allowing students to manipulate this data in a computer interface.

II. Pre-commissioning and Professional Training

vital

Introduction

The Armed Forces conduct education and training solely to satisfy the need for effective manpower to support the nation's defense. Therefore, they consider education and training as a sub-system within the personnel structure. The Armed Services have formed similar organizations for satisfying their education and training needs: the Naval Schools Command, the Continental Army Command, and the Air Training Command. Although these training commands are thought to be the only centralized training functions in each service, that is, in fact, not true. The problem of interface between the education and training activity and its "customer" activity is very much in evidence in the Armed Forces. For example: the Air Force's Air Training Command (ATC) trains jet engine mechanics to a specific level of competence. To date, it is rare for the Strategic Air Command, Tactical Air Command, or Air Defense Command to employ the product of the technical schools of ATC without significant transitional or on-the-job training (OJT). Both the Army and Navy confront similar problems in their technical training; training is conducted at all levels of organization, in efforts that range from very informal to highly formal degree-granting schools.

Recipients of pre-commissioning, graduate, and professional training are generally officers, and the technical training student population is mostly enlisted personnel. While this distinction is not absolutely clear-cut, the investigator makes it in order to organize his observations. This monograph (first of three) describes the instructional technology in officer training of all kinds within the military services.

Pre-Commissioning Training

Within the Armed Forces the two largest facilities for development of Commissioned Officers are the Reserve Officer Training Corps programs of the Army, Navy, and Air Force, and the three Service Academies. (I am told the Army's Officer Candidate Schools produce more officers than West Point.) The service academies (Navy at Annapolis, Army at West Point, and Air Force in Colorado) are accredited undergraduate academic institutions. They are very similar to civilian colleges in their curriculum development and management; they are dissimilar in that their curricula tend to be more product oriented than the normal liberal arts college. All three institutions have developed the uses of traditional instructional technology in parallel with the growth of technology in American education. In fact, several technological innovations have originated within these service institutions. For example, the first use of the chalkboard in an American college was at West Point. At present, such traditional audiovisual media as the overhead projector, slide projector, motion picture, and language laboratory are thoroughly integrated into the instructional process in each of these institutions. Table I provides a comparison listing of the numbers of films and other conventional audiovisual equipment and materials presently in use at each of the academies.

TABLE I

AV EQUIPMENT AND MATERIALS AT THE SERVICE ACADEMIES

	USNA	USMA	USAFA
16 mm Films in Library	3310	940	2825
16 mm Motion Picture Projectors	187	60	96
35 mm Slide Projectors	79	81	126
35 mm Slides in use	2000	26,169	13,280
Overhead Projectors	244	290	280
Film strips in Library	*	*	450
Film strip projectors	12	28	32
Audio Tape Recorders	106	75	130
Audio Tapes in Library	11,613	3,100	803
Video Tape Recorders	4	7	8
Video Tapes in Library	250	670	300
Opaque Projector	52	13	30
TV Receivers/Monitors	26	375	150
TV Large Screen Projectors	*	3	2

*Not available

All the services have accepted the overhead projector as a basic instructional device. This device, in particular, was invented several years ago by the Navy's Training Devices Center to serve the military instructors' need to face their students while presenting information. Since its initiation into military training, it has become almost as commonplace as the chalkboard. The academies reflect this same pattern of using the overhead projector in nearly every classroom. For instance, the Air Force Academy provides 280 overhead projectors to serve approximately 300 teaching stations.

The motion picture is used a great deal for instruction. From Table I, the extent of use can be generally gauged on the basis of numbers of film and projector holdings at each institution.

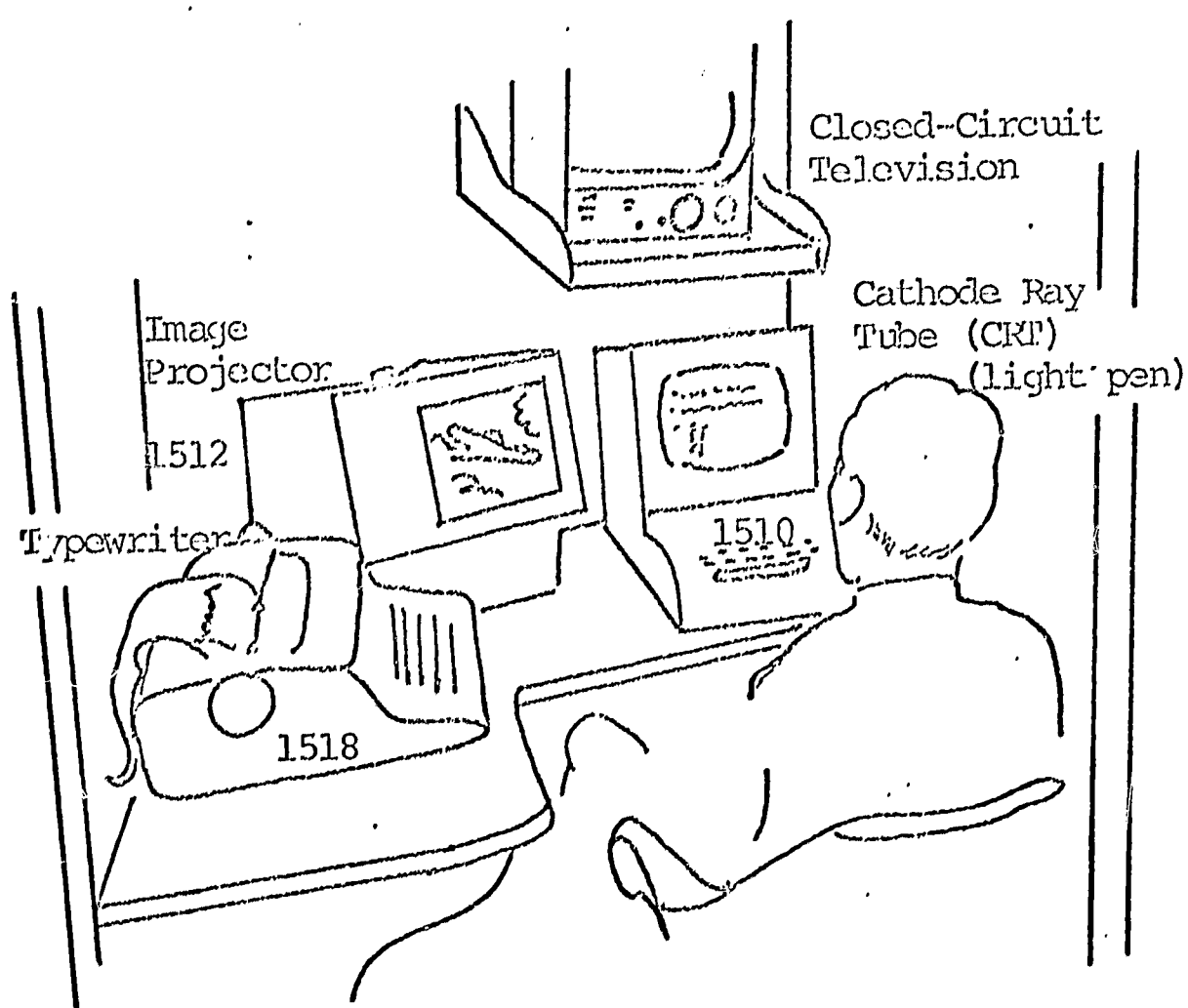
Similarly, 35 mm slides and audio tapes are an integral part of the instructional process. The production of these photographic slides runs into the thousands each year. Audio tapes, while primarily consumed in support of the language laboratory, are used for such other purposes as recording of student and instructor presentations and providing recorded musical and dramatic selections in various classes.

The newer media--television, programmed learning, and computers--are each being used and/or experimented with in the academies. The Naval Academy is attempting to develop a breakthrough in the uses

of the computer for learning. In a "Multi-Media" project which is funded in part by the U. S. Office of Education, a systematic structuring of the learning process has been undertaken. Under contractual arrangements, commercial firms are developing three complete undergraduate courses: Economics--Sterling Institute; Physics--New York Institute of Technology; Management Psychology--Westinghouse Learning Corporation.

Also at the Naval Academy, a tutorial mode experiment in computer assisted instruction (CAI) is under way. The courses being developed for CAI are Thermodynamics, Electrical Science, Modern Physics and Basic Russian. At the moment, one classroom with twelve fully equipped terminals is in use, (see illustration, page seven) with an additional classroom having eighteen terminals to be provided this academic year. Finally, at Annapolis, the use of the computer in the problem-solving mode is being exploited with seventeen teletype terminals to support eleven courses. Ten of these terminals are clustered in a classroom--the other seven are located conveniently for faculty and staff use in problem solving and course development.

The complexion of training in computer sciences at both West Point and the Air Force Academy is similar. Both institutions are concerned with the question, "What does a commissioned officer need to know about the computer sciences to serve his country successfully for the next 35 years?" West Point provides for both the learning



1 5 0 0 STUDENT TERMINAL

U. S. Naval Academy

of computer languages and the manipulation of electronics hardware in the curriculum. The Air Force Academy treats these two aspects of computer sciences, but with most emphasis on languages and less emphasis on student interaction with hardware.

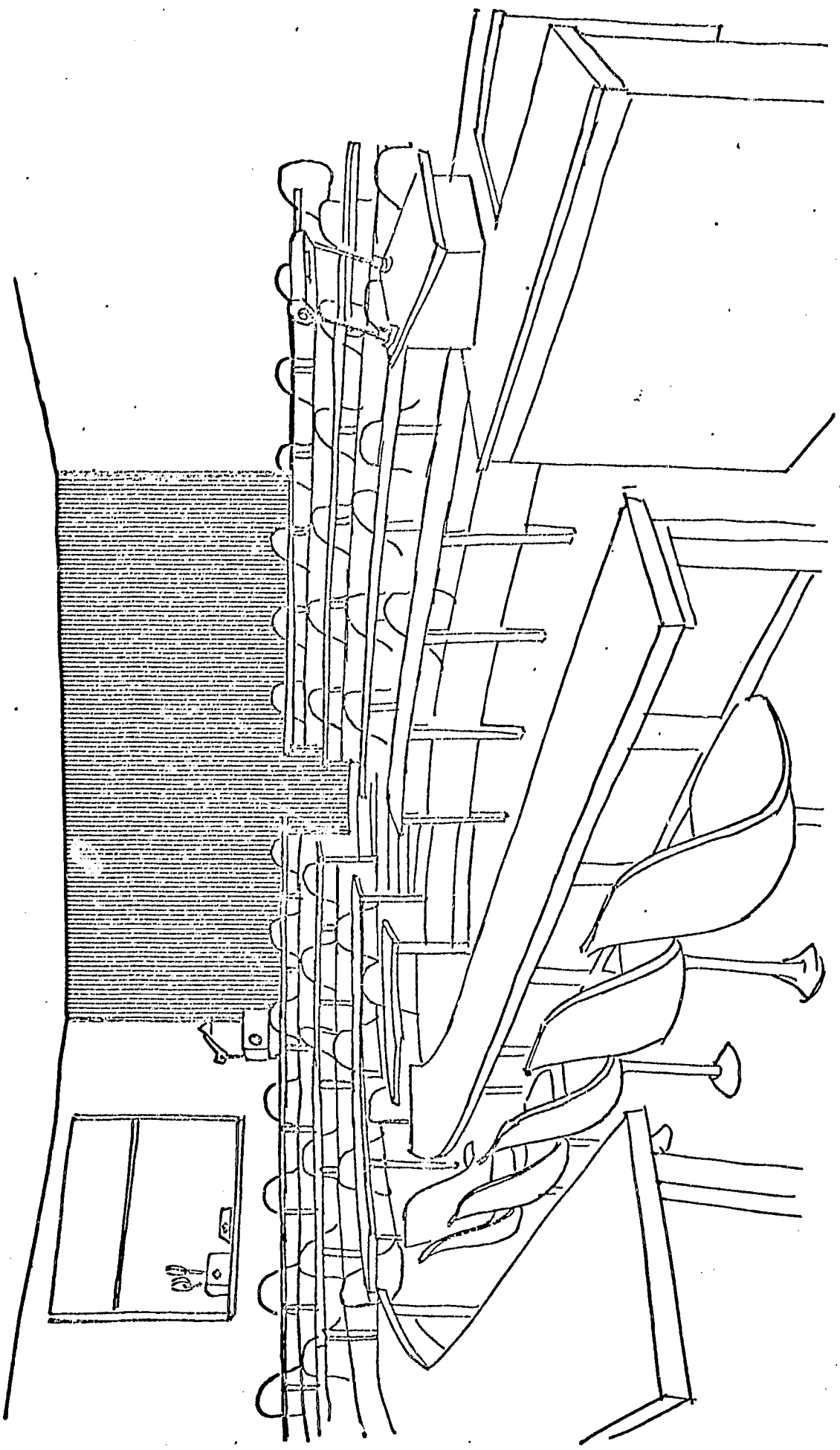
The introduction of programmed learning into the curricula of the service academies has been slow. Generally, programmed learning has been used to satisfy remedial needs with the cadets and midshipmen, e.g. remedial programs in basic English, Mathematics, and Map Reading. The Air Force Academy mails both English and Mathematics programmed texts to entering students to complete before their arrival. It found this technique improved the verbal and mathematical skills of entering students who were weak in these areas. The Naval Academy and the Air Force Academy have programmed some out-of-class, or homework, activities in such subjects as Financial Management, Place Identification in Geography, Operations Research, Electronics of Weapons Systems, and Principles of Physics.

The use of television within the Academies has paralleled that of civilian institutions in the past ten years. All three institutions are still exploring the medium with the hope of some significant breakthroughs in its use. Few complete courses are being taught through the medium. Generally its ability to enlarge and reduce visual phenomena and provide everyone a front-row seat

at demonstrations benefits most students. The Air Force Academy introduced the instructor-centered concept of TV program production (letting the teacher manipulate all of the audio-visual inputs into a television program by himself) in 1961. This innovation led to such devices as the Ampex Video Trainer, a self-contained, portable TV record and play-back unit. Television usage at the Naval Academy has undergone late development in the Naval Science Department and is only now beginning to enjoy wide-spread use.

The language laboratory is the only identifiable effort to give students access to information in a dial-access or remote-access mode. Even here students generally use the laboratory only under the direct control of a live instructor. The Departments rarely make the laboratories available to the students outside scheduled classroom periods.

Some innovations in facility design are in process. The mobility of the Teletype terminal is being exploited to provide cadets with relatively flexible access to the computer programs at West Point. At the Naval Academy, the Multi-Media and CAI projects are evolving newly designed learning carrels (see illustration, page seven). At the Air Force Academy, the need for more flexibility of scheduling caused the design of some intermediate-sized rooms (76 seats) when the new academic facilities were constructed. The architect dubbed these rooms "lectinars" (for lecture-seminar, see illustration, page ten).



The issues and trends which seem prevalent at the service academies are the same ones occurring at civilian colleges and universities:

1. The individualization of instruction is recognized as desirable. However, tradition mitigates against the breakdown of the very favorable student-instructor ratio (less than 20 to 1), which prevails at the academies. Because it is felt that control of the intellectual, social, and character development of these officer-leaders must remain in the hands of professional officer-teachers, the surrendering of the instructor's prerogatives is difficult to accomplish. Obviously, increasing the use of machines and media seems at cross purposes with this human management of learning.

2. Standardization of instruction would seem to be enhanced by more use of the communication media. The issue at the Academies is not standardization, but the proper balance between the employment of media and the human teacher to continue satisfying the requirements of the accrediting agencies. The academies must maintain a balance between becoming "trade schools" and keeping enough of a general education thrust to the curriculum to ensure that the degrees which they grant are recognized and have transfer value.

3. The keeping of the curriculum itself and its implementation as a dynamic process is very important. The rapid rate of

technological change in weaponry and all the applied sciences does have a significant effect on the substance of these undergraduate curricula. This, coupled with the changing technology of instruction, tends to keep the programs of the academies dynamic.

4. The problems encountered in the employment of technology in the service academies, as in civilian institutions, are generally "people problems". Some hypothetical questions, attributed to military professors as well as their civilian colleagues, illustrate the problems: "Will the use of technology enhance my academic image?" "How will my colleagues in civilian education view me if my department has less instructors than theirs?" "Isn't this technology a dehumanizing influence on my students?"

The largest source of commissioned officers in all three services is the Reserve Officers Training Corps program. Detachments of active duty military personnel from the appropriate services conduct instruction in more than 400 undergraduate civilian institutions. Because this instructional program is embedded in a civilian institution, it generally tends to take on the methodological complexion of its host. Instructional technology is employed generally to ensure standardization of instruction and, hopefully, learning across the several hundred detachments. The primary curricular tool is textual materials developed very carefully in each branch of the service through

the course development and lesson planning process. Prescribing appropriate motion pictures and other training aids in each hour's lesson plan achieves some standardization. Generally, the logistical problems of supporting geographically separated and numerous detachments have inhibited the budgeting for and developing of newer media. There are exceptions. For instance, one of the initial courses developed and adapted for TV instruction at the Pennsylvania State University in the mid-50's was the basic ROTC Course. Again, the operation of ROTC instruction tends to imitate its host institution.

In general, however, the amount of instructional technology employed and the sophisticated level of use is far in excess of that employed in the typical civilian college. This is true not only at the ROTC detachments around the country, but particularly in the three academies.

Graduate and Professional Training

Degree Training

The Armed Forces conduct a number of high-level courses, often at the graduate level, primarily for their officers' professional development. These courses sometimes lead to graduate degrees and in more than half of the cases, although not aimed toward a degree, are essential for continued development of the officers. The military institutions primarily concerned with degree programs are the Naval Post Graduate School at Monterey, California, and the Air Force Institute of Technology (AFIT) at Wright-Patterson Air Force Base, Ohio, a sub-unit of the Air University. The Naval Post Graduate School is accredited to grant BS, MS and PhD Degrees. AFIT grants Masters and Doctoral degrees.

In addition both of these military institutions manage degree programs with several civilian colleges and universities around the country to assist in filling the need for officer education. In recent years, the total program of the Air Force, Navy, and Army (which does not have an "in-house" accredited graduate school) graduated approximately 2,000 students per year. The Naval Post Graduate School in 1967-1968 granted the following degrees: 252 BS Degrees, 323 MS Degrees, and 3 PhDs.

The Navy and Air Force resident graduate schools lean heavily on communication media to accomplish instruction. These media range from overhead transparencies through more sophisticated photographic products, programmed materials, television, and computers.

Characteristic of both resident programs is their use of television for such activities as instructor training (allowing the less experienced instructor to confront himself recorded on video tape) and distributing pre-recorded lectures by subject matter experts to students so that they may have the benefit of the best teachers the school has to offer.

The concept of use of television at the Naval Post Graduate School includes a considerable amount of decentralization of equipment. Facilities are provided for image enlargement in engineering and scientific classrooms, visual monitoring of hazardous experiments and getting at physical phenomena not readily seen otherwise.

Two distinctive developments at the Post Graduate School are (a) the use of video taped presentations of guest lecturers to precede a live telelecture and (b) the introduction of the "curricular officer" concept. The curricular officer concept arose from the fact that the Post Graduate School faculty, primarily civilian, faces the problem of keeping its training relevant, i.e., meeting the needs of Naval operations. To assure that the training is

relevant and appropriate, a procedure of using officers who have been trained and have served in the professional skill within the Navy return for a tour at Monterey and translate the field's needs into the academic program.

Both institutions have rather exotic laboratory equipment. For instance, the Engineering Sciences curriculum of AFIT uses a working scale model of a 20 ft. wind tunnel, capable of producing velocities in excess of 300 miles per hour.

The Air Force Institute of Technology has a project under way to simulate the decision-making processes necessary in the Civil Engineering program within the Air Force. This ability to simulate such a complex process has only become possible with the advent of the large capacity digital computers presently available.

Non Degree Training

Turning now to the non-degree professional training area, it can be seen in Table II that professional military training takes place at seven possible levels. The approximate rank and years of service of the typical officer attending school at a given level is indicated in Table III. As an individual progresses through the seven levels of education he finds that the selectivity becomes more competitive and that fewer persons attend the higher level schools. For instance, less than fifty percent of the active duty

TABLE II

PROFESSIONAL MILITARY EDUCATION PROGRAMS
OF THE ARMED SERVICES

Level	Army	Navy	Marine Corps	Coast Guard	Air Force
1	(Commissioning Programs, i.e. academies, ROTC, OCS, and so on)				
2	Branch Schools (Orientation Course)	Surface Submarine and Flying Schools. Officer Special Schools	Basic School	Naval Schools	Pilot-Navigator, and Specialty-Training Programs of Air Training Command
3	Branch Schools (Career Course)	Naval Post Graduate School	Junior School	Naval Schools	Air University; Squadron Officer School
4*	Army Command and General Staff College	Command and Staff Course (Naval War College)	Senior School	Other Service Command and Staff Schools	Air University; Command and Staff College
5	Army War College	Naval Warfare Course (Naval War College)	Other Service War Colleges	Other Service War Colleges	Air University; Air War College
6	National War College; Industrial College of the Armed Forces	Same	Same	Same	Same
7	NATO Defense College	Same	Same	Same	Same

*Between the fourth and fifth level specified numbers of officers attend the Armed Forces Staff College at Norfolk, Virginia.

TABLE III

LEVELS OF PROFESSIONAL MILITARY EDUCATION

Level Program	Equivalent Rank Average Officer	Approximate Years of Service
1. Commissioning programs	Cadet	0
2. Initial-training programs	Second Lieutenant	1
3. Career-training programs	Captain	5
4. Command and staff colleges	Major	12
5. Senior service colleges	Lieutenant Colonel	19
6. National and joint colleges	Colonel	22
7. Combined college (NATO)	Colonel	22

officers in the Air Force graduate from the Squadron Officers School (level three); less than 700 officers attend the schools in levels six and seven out of approximately 700,000 officers in the military services.

The methods of instruction in these professional schools range from highly individualized independent study (primarily in the preparation of reports and papers, language study, and reading improvement labs) to large lectures given live or over television. As indicated earlier, these schools use a great deal of traditional audiovisual media: slides and transparencies, motion pictures, and three dimensional models or mock-ups. Listed in Table IV is a summary of materials produced by the Audio-Visual Center at Maxwell Air Force Base for a recent year:

TABLE IV

2" x 2" slides	165,000	
3 1/4" x 4" slides	15,000	
16 mm microfilm (frames)	567,000	
35 mm microfilm (frames)	600,000	
Photostats	17,000	
Transparencies (8" x 10")	2,500	
Transparencies (7" x 7")	200	
Charts, Posters, Graphics, Maps	22,400	
Illustrations	1,500	
TV special visuals	1,200	
Displays	25	
Magnetic Tapes	850	(hours)
Models and mock-ups	25	
Tapes	1,000	
Video tapes	100	

Two formal courses conducted within the general realm of professional military training deserve special notice. The first of these is a one week indoctrination into the uses of television for communication which is conducted at Redstone Arsenal, Alabama, for middle-management officers of all the services. This course is highly mediated, using the technique of embedding the briefer in a carefully structured sequence of audiovisual events. In this technique the briefer works with television displays, live dramatic skits by other instructor personnel, and multi-media presentations on a wide screen. The course's purpose is to interest Commanders and military managers in the use of television for solving their problems; and it is quite successful if the enthusiasum of attendees is the measure of that success.

The other course intended to enhance the professional ability of instructors in the Air Force, is the Academic Instructor Course conducted at Air University, Maxwell Air Force Base, Alabama. The course is six weeks long, carefully organized, and emphasizes student performance; it develops an appreciation for the ability to use both the traditional audiovisual media and television for instruction. Though television has been used there for several years in instructor training, it is interesting to note that very little of the core instruction is accomplished through the television medium. In the

context of this course, television is used as just another audio-visual tool to provide a self-confrontation and critiquing capability for the instructors in training.

Programmed instruction is in use in the professional programs, but generally only as textual material to be completed outside of formal classroom periods. Rarely, if at all, is a programmed text used to carry the main body of information to students in the classroom. Such programs as the Principles of Test Construction and Grading, as well as PERT techniques and other linguistic or procedural skills have been found amenable to programming. The use of programmed materials in officer training throughout the armed forces is much less than in the larger technical school system which deals with technical knowledge and motor skills.

III. Opinion, Trends, and Outlook for the Future

Total

Trends

The public tends to view military training activities as extremely affluent and on the cutting edge of innovation and developmental activities, particularly with regard to technological applications to training. And it is true that the military services expend great quantities of money to insure that their personnel are adequately trained. This, perhaps more than any other fact, characterizes military training activities.

The most significant trend in military training seems to be the more careful specification of training. This is being accomplished systematically and, perhaps, grew out of the task analysis originally introduced in the programed learning techniques. The Army labels this kind of activity "functional context training." This means that only those specific skills necessary to make the person capable of performing quite explicit tasks should be provided in the technical training schools. For instance, research within the Army's Human Resources Research Office (HumRRO) has demonstrated that a traditional basic electronics course is not necessary in the overall curriculum for an electrical maintenance technician. In fact, the Army Signal School has a carefully designed project under way to develop a Common Basic Electronics Training Course (COBET). Some work with the functional context notion at Redstone Arsenal is aiding this effort. Also, the Army has reduced the Missile

Systems Maintenance Technician course from 19 weeks to 12 weeks through the course tightening which results from such analyses.

A second significant trend is to employ media in an even more systematic fashion in military training. Military trainers increasingly recognize the need for a strategy to use in managing the technological tools of communication. It is hoped that the major research effort of Army's HumRRO Project IMPACT will contribute more evidence to facilitate this trend.

The trend toward individualization of the learning process has been underway for some time in the military. Implementing that concept presents some difficulties. A classic example is assigning personnel to KP who complete a fourteen week course in twelve weeks through the use of individually paced programed instruction because "there's no other way to handle them". In spite of such difficulties the use of programed learning has become nearly routine within the services--similar, for instance, to the use of a lesson plan.

Developments in both the general technology of weaponry and machinery of defense, and the technology of training will have an impact on the posture of military education and training in the future. An example of subtle technological change is the decreasing requirement for radiomen to know Morse Code--more sophisticated encoding hardware permits secure voice communication. As undersea exploration increases and America begins landing flight crews on

the Moon and beyond, the defense posture must change. Just as the Mercury space flight project developed concentrated food which has become available in the supermarket, future space ventures will profoundly effect our military posture. Even though we sometimes believe that we engage in some human activities because our technology makes them possible, military technology must continue to improve. Military training will continue to depend upon the best empirical research results available and will remain in the forefront as a complete technology of instruction evolves.

Future

No discussion of media and technology is complete without some mention of future plans and applications. The future employment of traditional audiovisual media seems to be evolving within the systems development concept--approaches to training will become more systematized in the services.

Presently the Navy is developing both slide/tape instructional packages and 8mm cartridge films for follow-on skill training for use of personnel aboard ship. A skilled training specialist does not need to administer these packages. Complete "how to do it" packages for various jobs are being developed for circulation throughout the fleet in this form. The Air Force also has slide/tape packages under development for use in a "library" fashion on-the-job and has extended this technique to undergraduate pilot training for the day-to-day task of maintaining proficiency in certain skills.

Although television has become a readily accepted medium for military instruction, many of the training managers expressed some dissatisfaction with the way it has been employed. As an example of the kind of development taking place, the Navy is conducting a technical development project to reassess the role of TV in training. This project looks at television systematically as a medium for:

a. whole process learning (carrying the entire instructional message through the television medium)

b. supplementary learning

c. single concept learning

d. self-instruction

e. remedial instruction

f. presenting drill exercises

The Air Force applies portable television recording equipment to the problems of undergraduate pilot training, recording the cockpit environment and the pilot's perceptions outside the cockpit during various training maneuvers. Training personnel hope that using such recorded experiences in the ground classroom will facilitate the student's actual performance in the air. Television's ability to record visual images easily and play them back immediately excites the experimenters, and is being exploited more and more.

The greatest problem which deters trainers from using the computer more extensively is not the availability of hardware or money; it is instead the difficulty of accommodating the student to the machinery. Many of the researchers in all three services expressed the need for a more natural language for the computer user. A great deal of the research taking place in various civilian institutions with computer assisted instruction addresses itself to the development of more powerful and simpler computer languages.

Additionally, the Armed Forces look at the computer not so much as a device for direct teaching as for a device to assist instructional decision makers and to make them more efficient. For example, the computer managed instruction project which is now underway at the Naval Air Technical Training Center has exactly that thrust. In this development project, the computer will only manipulate student data and help guide the student's sequence of learning activities; the student's primary learning activities will come through interface with various other more traditional audio-visual media (slides, audio tapes, films, etc.).

The major Army computer research project is the Human Resources Research Office Project IMPACT -- a five-year advanced development project designed to produce three outcomes:

1. A prototype computer-administered instruction (CAI) system which the Army can put into operation;

2. Several CAI programs of instruction dealing with different kinds of subject-matter of critical importance to the Army; and

3. A decision model of the instructional process -- a set of rules for deciding precisely which learning materials to present next to a particular student based on his personal characteristics, his previous "learning history," and scientifically established principles of learning and teaching.

The project, funded at 4.3 million dollars, is aimed at a very systematic evolutionary approach to organizing education and training within the Army.

Opinion

What is there in military education and training that the civilian education sector can use? Are lessons to be learned? Are specific techniques applicable?

It is "beyond the scope of" this paper to list specific techniques or methods which have been proven in the military and can be used by the rest of American education. However, some general principles can be cited and some useful observations can be made. It must be remembered that military education and training relates directly to the ability of the defense establishment to accomplish its mission. If the technician lacks the skill to maintain the computer, that electronic marvel will not perform.

For the above reason the Department of Defense expends great sums of money to insure that skilled personnel are available when needed.

On the other hand, the problems within military education and training are generally the same sort of problems that plague civilian education. An "establishment" comes into being, with all its conservatism and resistance to improvement which that sometimes odious term implies. On an individual basis, people themselves tend to become bureaucratic and resistant to change. Innovation, where it occurs, depends a great deal on the "climate" created by the leaders and managers of training.

The military establishment knows its mission--it therefore can design the training process with a great deal more specificity than can civilian education. With this realization, the trend is clearly established toward even more systematic design to insure the desired training outcomes. Systems engineering is no longer applied just to the development of hardware or weapons systems. The techniques of systems engineering are being applied to the instructional process and much needed instructional design techniques are evolving. Military training activities are beginning to package segments of courses for the training consumer. Significantly, military trainers are re-examining the traditional audio/visual communication media with the hope of developing some strategy for their employment in the structional process.

Another factor which differentiates military from civilian education is that the provision of a complete spectrum of audio-visual support for the instructor has became traditional since World War II in the military services. Although the military instructor must operate certain pieces of audiovisual equipment, he has not produced the projectual materials, films, etc. that are used with this equipment. The fact that audiovisual support is traditional in military training has produced some very sophisticated training aids; working models, cut-aways, mock-ups, and other devices which aid the demonstration of concepts, processes, and procedures, are a

normal part of the spectrum of support for the military instructor. This is clearly different from the support provided for the normal public school teacher (she often uses the janitor's talents).

Teacher training is clearly different in the Armed Forces. The instructor training courses conducted at all levels of training are organized around the rationale of "minimum theory, maximum performance," and these courses effectively develop skilled presenters of information, this, despite the fact that military instructors are generally "doers", not professional teachers.

The constant re-examination of the total training process has given rise to some significant changes in the training materials. Textual materials have been found wanting in many instances. Only recently, since the advent of Project 100,000, did the Navy realize that its basic Blue Jacket Manual was unreadable at the reading level of entering enlisted men. The manual has been re-written. In like vein, the Air Force's dependance on "contractor provided" technical manuals as texts for maintenance training has come under scrutiny. Maintenance manuals are being restructured to make them more usable in training and in performing maintenance on the job.

The military services use the techniques of simulation a great deal in the teaching of psychomotor skills. Much of what we know about skill training has been contributed by them. Research

findings of such activities as the Human Resources Research Office, Office of Naval Research, and the Air Force's Human Resources Laboratory do contribute to the steadily developing body of knowledge about learning processes. This information should be made more available to responsible researchers and educational practitioners in the entire country.

The people who are concerned with the introduction and management of instructional technology within the military services are generally quite enthusiastic about its potential and the realities of its use. This enthusiasm very often beclouds the real state of the art. As in civilian education, the enthusiasts are full of plans and programs that are not quite in being; however, the military education and training establishment taken in general is using instructional technology with the same degree of sophistication and naivete as the civilian sector.

To summarize, the most important aspects of the uses of technology for education and training within the armed services are:

a. There is a direct relationship of training outcomes to the accomplishment of the military mission which causes more careful specification of learning objectives and training procedures.

b. Considerably more deliberate design of the instructional process seems to be evident in the military than in civilian education.

c. Complete media support of the instructional process is traditional.

d. Competence in the use of hardware and other instructional materials is very much a part of the instructor training which takes place at all levels within the military training establishment.

e. The individualization of learning is being implemented in the military despite its inherent difficulties in the highly structured military training environment. Programed learning packages which enable student paced completion are in rather extensive use. Most of the thrust here is to enable the person to learn while on the job, not in a school setting.

f. Simulation is used extensively to develop psychomotor skill learning. A great variety of simulators are employed, ranging from simple to very sophisticated electronic devices.

g. Military training managers continually expressed the need for more efficient information exchange between the civilian and military sectors, and between the researchers and the practitioners in the use of instructional technology.

INSTRUCTIONAL TECHNOLOGY IN THE ARMED FORCES

by

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This report is the result of selected visits to Armed Forces education and training activities and many conversations with personnel thus engaged in the military services. Obviously, all activities could not be visited and personal interactions could not be had with everyone; therefore, let me apologize in advance for those oversights or seeming lack of detail in this summary.

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